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Analysis of Sachet Water qualities produced in Uli, Ihiala Local Government Area, Anambra State, Nigeria

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Abstract
The purpose of the study was to determine the quality of sachet water sold and used in Uli. Eight samples comprising different types (Aquamax, Chinagorom, Marcon, Zona, Sassella, Chy-Jenon, Elesco and Jeffkings) are the most widely used sachet water in Uli were used in the study . The physical, chemical and microbiological properties of the eight species of sachet water have been evaluated to ensure compliance with the standards recommended by the World Health Organization and the National Agency for Food and Drug Administration and Control. Specified parameters include odour, taste, pH, temperature, turbidity, conductivity, magnesium, sodium, potassium, sulphate, chloride, nitrate, lead, cadmium, mercury, faecal coliform count, total coliform count and escherichia coli. Data analysis based on Student t-test and Pearson affiliation showed that restrictions on the eight types of sachet water were within the World Health Organization and the National Agency for Food and Drug Administration and Control drinking water restrictions. It was therefore concluded that the level of sachet water used in Uli is safe to drink as it is within the World Health Organization and the National Agency for Food and Drug Administration and Control. It is suggested that there is a need to periodically check the water quality of the sachet, and to compare these physical, chemical and microbiological parameters with existing standards to determine whether they are safe for human use.
Key Words: *Analysis, water, quality, pollution, sachet, standard, health*

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I. Introduction

Water like air is one of the most important things in life. It is only when we are deprived of these things that we can truly appreciate their value (Dada and Ntukekpo, 2005). Good drinking water is fundamental to the human body, and human survival depends largely on its availability. Because of its abundance in nature everywhere; and the ability to dissolve anything, is considered the most effective solvent in the world. The resources are found in springs, rivers, springs, natural lakes, ponds and rainforests.

During soil erosion, water dissolves minerals in rocks, accumulating suspended maters and particles, mainly from organic, heavy metals and pathogenic microorganisms from wildlife and agricultural chemicals. These and other factors make water unsuitable for drinking (Raymond, 1999). Therefore, the level of treatment required is determined by the level of the raw water source (Macrae *et al,* 2003). In many developing countries, access to water has become a major issue that requires urgent action.

This is a particular problem for families and communities depending on the non-public water supply system (Edema *et al,* 2001). According to a 2004 World Health Organization (WHO) report, about 30% of Nigerians have access to safe drinking water. In developing countries, statistics also show that 80 percent of all illnesses and deaths are more than 30% related to water (Dada and Ntukekpo, 2005). Because of the magnitude of the health risks associated with water, public water must be healthy, tasty and must meet the standards of the National Agency for Food and Drug Administration and Control [NAFDAC] and the World Health Organization (WHO) for water quality (Osibanjo, 2000).

The Institute for Public Analysis has declared that 50% of "clean water" products on the streets of Lagos may be unfit for human consumption (Oyeku, 2001) and this has made this research work. Perhaps this proclamation could be applied to other cities around the world.

Water packaged in polyethylene bottles and sachets reached the Nigerian market in the 1980's (Pip, 2000). They were well received and often worked at hotels, restaurants, events such as conferences, symposia, weddings and special events. Today, sachet water is found throughout Nigeria.

The average cost of one litre of bottled water at the time of the emergence of 8 naira (N8) due to the fact that bottled water was not readily available and affordable for many low-income people, bagged water became cheaper, another option that could be easily used. was introduced to the Nigerian market in 1990 (Pip, 2000).

Today, the production and sale of packaged water is a thriving business found in all parts of the country, especially in car parks, city intersections, stadiums, restaurants such as hotels and restaurants, and other places of intense economic activity; in cities and villages.

Before water can be defined as drinking, it must comply with certain physical, chemical and microbiological quality standards designed to ensure that the water tastes and is safe to drink (Tebutt, 2007). This identified the need to investigate the physical, chemical and microbiological properties of sachet water produced in Uli to ensure its suitability and compliance with NAFDAC / WHO standards for portable water quality.

II. Environmental Setting

2.1 The study area

Uli study area in Ihiala Local Government Area of Anambra State, located at latitude 5^0 46^1N and 5^0 48^1N and lengths 6^0 45^1E and 6^0 47^1E. It is located between 43 and 49km^2 on Onitsha - Owerri road in the southern part of Anambra State. Administratively, the site is bounded by Amaofuo and Ubulu in the northeast, Ibiasoegbe and the Amorka city in the east. On the South-East border are the villages of Egbuoma, Ozara and Ohakpu. These cities outside of Amorka are located in the Imo State of Nigeria. In the North, it has common borders with the towns of Ubuluisiuzor, Mbosi and Ihiala in Anambra State. The study area covers an area of 256 square km^2. The town is located in a transition zone between the equator and tropical rainforests of Nigeria. The climate here is influenced by two major trade winds: warm southwest trade winds during the rainy season (April - October) and North-East trade winds during the dry and dusty harmathan (November - March). Dry season is characterized by dry and dusty air, which causes high water respiration and water levels. The rainy season is characterized by severe flooding, soil leakage, groundwater infiltration and drilling (Egboka and Okpoko, 1984). The temperatures are generally high (the highest monthly temperature varies from 780F and 810F). Normal temperatures have not changed throughout the year around 770F with high temperatures occurring in the period December - March and the minimum of the season (June - September). It has an average annual rainfall of more than 2000 mm per year, which is a very high rate. Most of the rains fall in the middle of (mid-March and mid-November), although it is rare, there may be rain during the dry season. Rain during the dry season is mostly dewy. This is usually high all year round, with numbers between 60% and 90%. The humidity associated with wet months is 90%, and the dry months of (November to March) are 60% - 70%. Very high relative humidity figures are obtained during the rainy season and very low value during the dry season. Geographically, the areas are located in the stratigraphic region of the Niger Delta sedimentary Basin. This area is often covered by members of the mappable lithologic of tertiary to the recent Benin Formation (Coastal plain sands) and Alluvium. Miocene (23.3Ma - 5.2Ma) Benin Formation is part of the smallest rock stratigraphic in the highlands of the Niger Delta and consists mainly of yellow and white continental sand, alternating with a pebby layer and a few clay beds. Stones and stones are buried in a large matrix of continental sandstone. Sands often intersect when clay and sandy clay occur in lenses. Topographically, this area is usually low and has a height of (32m - 76m). The texture of the local soil appears red - the units are brown sandstone, rock, gravel and muddy sand. These have small holes, are accessible, are not compacted and are extremely leaky, so they are poor in agricultural nutrients and are at risk of erosion. A small alluvial brown soil is extracted from the tributaries of the Usham and Oguta floodwaters, usually fertile and highly supportive of agricultural activities. The main water sources in the area are the Atamiri River, the Ubahudara stream and the Usham Lake. The flow rate is largely controlled by local topography. The flora and fauna of this region is concentrated in tropical rain forests. Trees are very tall, and domesticated or economic trees such as mangoes, palms, guavas, oranges, almonds, etc. are found. Some of the trees are strong and some are soft. Many native plant trees have been cut down and the soil used for development; such as road construction, university campus and the construction of hostels with other commercial implications and higher education on plants. The total population of the Ihiala Local Government Area was 302,796 according to the 2006 census. Then the population in the study area (Uli) from 2006 was estimated at 10,950. However, the 2021 estimate is estimated at 12,962 with an annual growth rate of 2.85%. Agriculture is the main settlement of the Uli people. A few public services in the city are run by non-natives. The majority of the indigenous people view farming as a profession. A few do traditional handicrafts such as fish nets and baskets on a very small scale, others are placed on a traditional tray, axe and plow stick etc. Some women especially make soap (traditional soap). The men enter the oil press in the palm oil field. The oil is sold and eaten locally and the nuts are later crushed and exported by the middle men, the seeds in the shell are used to make local pomade. Although all these men and women participate in all these activities but their main work is farming; since not a day goes by that they do not go to the farm. Uli as a rural area is now a commercial and high-rise rural area due to the influence of the University, It has led to many jobs especially banking, small business etc. The area has become a fast-growing rural area with a large percentage of migrants such as (Hausas) and student entry into the area.

2.2 Selection of the sample

This preliminary site survey was conducted from (2 September to 13 October, 2021). The aim was to find out if those sachet water industries were in the research area. During field research; interviews and observations were used to understand the type of sachet species of water produced locally. The results of the first field survey provided information on a sample of 32 sachet water species to be selected and studied. Based on the outcome of the oral discussion; the sample was randomly selected i.e. the most popular types of sachet water were identified and selected for analysis. As a result of time and financial constraints in studying the properties of sachet water in the area; eight (8) samples were selected or drawn as representatives of the total population of thirty-two (32) water samples. The most popular types of sachet water selected for study are referred to in this work as; sachet water -1 (AQUAMAX), sachet water - 2 (CHINAGOROM), sachet water - 3 (MARCON), sachet water - 4 (ZONA), sachet water - 5 (SASSELLA), sachet water - 6 (CHY-JENON), sachet water - 7 (ELESCO) and sachet water - 8 (JEFFKINGS) respectively.

2.3 Laboratory Analysis

Two (2) sachet of each of the eight (8) "popular water sachet" species were purchased for analysis. They were labelled as soon as they were collected. The products were packaged in frozen plastic containers for cooling or storage before being shipped to laboratory for refrigeration before being inspected the next day. Physical analysis of water samples was aimed at determining parameters such as odour, temperature, taste, turbidity and conductivity. Tasted chemical ingredients include; hydrogen ions (pH), sodium (Na^+), Magnesium (Mg^{2+}), Potassium (K^+), sulphate (SO_4^{2-}), chloride (Cl^-), Nitrate (NO_3), lead (pb), cadmium (cd) and mercury (Hg). Biological constituents include; total coliform count (TCC), faecal coliform count (FCC) and Escherichia coli (ECC) were analyzed in the laboratory.

2.3.1 Procedure for physical analysis

The material tested was odour, temperature, taste, turbidity and conductivity. The odour was determined by inhaling water samples.

The temperature is calculated using the use of a mercury measurement of degrees centigrade (Celsius) by inserting a thermometer which continues to rise until the final stable temperature indicates the temperature of the water sample at Celsius (^0C).

Turbidity of the sachet water samples was estimated by comparing the turbidity of the water with the sample of standard turbidity, by holding both samples side by side after thorough shaking.

Conductivity was tested in solution for ion flow using a conductivity meter.

2.3.2 Procedure for chemical analysis

Chemicals tested were for pH, magnesium, sodium, potassium, sulphate, lead, chloride, nitrate, cadmium and mercury.

Chloride is determined by argentometric titrimetric method. It was measured using compact disc in conjunction with the appropriate colour filter. Sodium content was determined using estimation method by titration. Magnesium and potassium ions are determined by complexometric titration method using EDTA salt and Eriochrome black T as a reference. Sulphate (SO_4^{2-}) and Nitrate (NO_3) are determined by the turbidimetric method using sulfaver reagents 4. The pH is determined using a pH meter. pH meter electrodes were thoroughly rinsed with distilled water before immersion in the sample with lead, cadmium, mercury was determined using 50ml chloroform Dithizone method added to the sample.

2.3.3 Procedure for microbial analysis

Microbial analysis was performed to determine total coliform (TCC), faecal coliform count (FCC) and Escherichia coli (ECC).

The methods are as follows: -

a. Total coliform count (TCC)

Multiple tube tests were performed using Mac Conkey Broth. Tubes were placed in 37 ^0C for 48 hours and the maximum probability of presumptive coliform bacilli per 100 ml of samples was measured in the Mccrady "MPN" tables.

b. Faecal coliform count (FCC)
The surface plate method is used. Samples were soaked in nutritious agar and incubated at 22 ^{0}C for 72 hours to isolate bacteria. Another set was placed at 37 ^{0}C for 24 hours to isolate parasite bacteria. Samples showed adverse effects.

c. Escherichia Coli count (ECC)
Negative tubes from the presumptive test were produced under the briallant Grease Lactose Bill broth and soaked at 44 ^{0}C for 24 hours. MPN E-coli per 100 ml sample was calculated using MPN tables. It showed negative results.

However, water samples of sachet (8) showed adverse effects, water samples were accepted as meeting the bacterial standards set by the American public Health Association (APHA) standard below 2.2 (< 2.2).

2.4 Statistical analysis
The data collected were subjected to descriptive statistical analysis. To test hypothesis 1, the distribution of the student t-test was used. Student t-distribution issued by W.S. Gossett, who published the work under the pseudonym "student" in the early twentieth century.

The student t-test formula is provided as follows

$$T = \frac{X - U_o}{SD/\sqrt{n}}$$

t = t – distribution
x = the mean of the sample population
U_o = the standard mean (NAFDAC/WHO STANDARDS)
SD = the standard deviation
n = the sample size

With a degree of freedom (n-1):

In a t-distribution, if $T_{cal} > T_{table}$ reject H_0. Otherwise accept.

To test hypothesis 2, the mathematical method used was Pearson correlation. Pearson correlation is a mathematical method used to compare performance relationships between related variables. It is useful to predict single variables on the basis of the hypothetical nature of the relationship between variance. In Pearson's interaction one tries to determine how a given change in a particular mutation affects other variables.

III. Results

3.1. Hypothesis Testing
Re-statement of hypothesis

H_0 : The level of concentration of the physical, chemical and biological constituents of the sachet water brands do not differ significantly from the NAFDAC/WHO standards

H_l : The level of concentration of the physical, chemical and biological constituents of the sachet water brands differ significantly from the NAFDAC/WHO standards

The one-sample t-test is available for testing the hypothesis I stated above. Where the decision rule is; Reject H_0 if $t_{cal} \geq t_{tab}$ otherwise accept.

From the sachet water quality analysis performed, the following findings have been observed. The results of the analysis on Table 3 showed that 100% of the samples that fall within the WHO and NAFDAC standards were pH, turbidity, conductivity, potassium, sulphate and chloride ions. Temperature was determined by ambient within the WHO and NAFDAC approved temperature limits. From the results of the analysis of the sachet water laboratory; lead (pb), cadmium (Cd) and mercury (Hg) were determined using the Dithizone 50 ml chloroform method added to the samples. They were considered to be absent from sachet water samples. Sodium (Na^+), nitrate (NO_3^-), faecal coliform count (FCC), total coliform count (TCC) and escherichia coli count (ECC) were also found to be absent from the water sample, which shows that the sachet waters have been treated for these harmful heavy metals and biological parameters. The statistical data (t-student distribution test) used to test the hypothesis showed that concentrations of the physical, chemical and bacteriological concentrations of sachet water did not differ significantly from WHO and NAFDAC drinking water levels of 0.05% significance level. Therefore, we accept the null hypothesis (H_o) and reject the other hypothesis (H_1)

Table 3.0: Result of the physical, chemical and microbiological analysis of sachet water

Samples	Odour (TON)	Taste (FTN)	PH	Temp (^0C)	Turb. (NTU)	Cond. Ucm/s	Mg^{2+} mg/l	Na^+ mg/l	K^+ mg/l	SO_4^{2-} mg/l	Cl^- mg/l	NO_3^- mg/l	Pb mg/l	Cd mg/l	Hg mg/l	FCC cf/u	TCC cf/u	ECC cf/u
Sachet water 1	U	U	6.8	24	0.8	24.0	0.6	0.0	1.2	2.2	6.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 2	U	U	6.9	24	0.8	18.6	0.3	0.0	1.0	2.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 3	U	U	6.5	24	0.9	22.0	0.5	0.0	1.0	2.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 4	U	U	6.7	24	0.9	20.0	0.3	0.0	1.1	1.4	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 5	U	U	6.6	24	0.9	26.0	0.29	0.0	1.2	2.0	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 6	U	U	6.6	24	0.9	19.5	0.4	0.0	1.0	1.8	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 7	U	U	6.8	24	0.8	16.5	0.2	0.0	1.2	1.8	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sachet water 8	U	U	6.6	24	0.8	18.0	0.5	0.0	1.0	1.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WHO Std.	……	……	6.5-8.5	Amb.	10	500	250	200	200	400	250	10	0.01	0.003	0.001	0	0	0
NAFDAC Std	U	U	6.5-8.5	Amb.	5	1000	20	200	10.0	100	100	10	0.01	0.003	0.001	0	10	0

Source: Researcher's Laboratory Intern, 2021.
Sachet water 1 = Aquamax Sachet water 2 = Chinagorom Sachet water 3 = Marcon
Sachet water 4 = zona
Sachet water 5 = Sassella Sachet water 6 = Chy-Jenon Sachet water 7 = Elesco
Sachet water 8 = Jeffkings
U= unobjectionable Temp = Temperature Cond = Conductance Mg^{2+} = Magnesium Na^+ = Sodium
K^+ = potassium SO_4^{2+} = Sulphate Cl^- = Chloride NO_3^- = Nitrate pb = Lead Cd = cadmium Hg = Mercury
FCC – Faecal Coliform count TCC = Total Coliform count ECC = Escherichia Coli
NAFDAC = National Agency for Food and Drug Administration Control
WHO = World Health Organization.

Table 3.1: Showing descriptive statistics of the minimum, maximum, range, standard deviation, and coefficients of variation of the parameters

Parameters	Min.	Max.	Range	Mean	Std. d.	C.V	WHO Std.	NAFDAC Std.
PH	6.50	6.90	0.40	6.688	0.135	2.02	6.5-8.5	6.5-8.5
Temp.	24.0	24.00	0.00	24.00	0.00	0.00	Ambient	Ambient
Turb.	0.80	0.90	0.10	0.85	0.053	6.24	10	5
Cond.	16.5	26.00	9.50	20.575	3.203	15.57	500	1000
Mg^{2+}	0.20	0.60	0.40	0.386	0.137	35.49	250	20
Na^+	0.00	0.00	0.00	0.00	0.00	0.00	200	200
K^+	1.00	1.20	0.20	1.088	0.01	0.92	200	10
SO_4^{2-}	1.40	2.20	0.80	1.838	0.272	14.80	400	100
Cl^-	4.00	8.60	4.60	5.713	1.373	24.03	250	100
NO_3^-	0.00	0.00	0.00	0.00	0.00	0.00	10	10
Pb	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Cd	0.00	0.00	0.00	0.00	0.00	0.00	0.003	0.003
Hg	0.00	0.00	0.00	0.00	0.00	0.00	0.001	0.001
FCC	0.00	0.00	0.00	0.00	0.00	0.00	0	0
TCC	0.00	0.00	0.00	0.00	0.00	0.00	0	10
ECC	0.00	0.00	0.00	0.00	0.00	0.00	0	0

Table 3.2: Summary of the t-test against the WHO standard

Parameters	Mean	Standard deviation	WHO standard	t_{cal}	Degree of freedom	t_{tab}	Decision on H_0
pH	6.688	0.135	6.5	-4.178	7	2.365	Accept
Turbidity (NTU)	0.85	0.053	10	-484.17	7	2.365	Accept
Conductivity(ucm/s)	20.575	3.203	500	-423.38	7	2.365	Accept
Mg^{2+} (mg/l)	0.386	0.137	250	-5169.1	7	2.365	Accept
Na^+ (mg/l)	0.00	0.00	200	….	7	2.365	….
K^+ (mg/l)	1.088	0.01	200	-5677.01	7	2.365	Accept
SO_4^{2-} (mg/l)	1.838	0.272	400	-4136.90	7	2.365	Accept
Cl^- (mg/l)	5.713	1.373	250	-503.38	7	2.365	Accept

Table 3.3: Summary of the t-test against the NAFDAC standard

Parameters	Mean	Standard deviation	NAFDAC standard	t_{cal}	Degree of freedom	t_{tab}	Decision on H_0
pH	6.688	0.135	6.5	-4.178	7	2.365	Accept
Turbidity (NTU)	0.85	0.053	5	-219.6	7	2.365	Accept
Conductivity(ucm/s)	20.575	3.203	1000	-864.88	7	2.365	Accept
Mg^{2+} (mg/l)	0.386	0.137	20	-406.17	7	2.365	Accept
Na^{+} (mg/l)	0.00	0.00	200	....	7	2.365	....
K^{+} (mg/l)	1.088	0.01	10	-254.37	7	2.365	Accept
SO_4^{2-} (mg/l)	1.838	0.272	100	-1019.91	7	2.365	Accept
Cl^{-} (mg/l)	5.713	1.373	100	-194.29	7	2.365	Accept

Results of the t-test in table 3.2 for test against the World health organization (WHO) standards and in table 3.3 for test against the National agency for food drugs administration and control (NAFDAC) standards shows that the null hypothesis (H_0) of no significant difference in the properties of sachet water produced in the study area and the standards is accepted in the pH, turbidity, conductance, magnesium (Mg^{2+}), potassium (K^{+}), sulphate (SO_4^{2-}) and Chlorine (CL^{-}) content of the water. Therefore one can rightly reject the alternative hypothesis (H_l). The implication of these decisions is that from the samples drawn, the above listed properties of sachet water produced in Uli do not defer significantly from the WHO and NAFDAC standards of an ideal drinking water. No decision was made for the sodium content as and all other parameters with zero content. This is because samples drawn have no standard deviation between each other thereby making the computation of their t-values impossible. From the result of the laboratory analysis of the sachet water, nitrate (NO_3), lead (Pb), cadmium (Cd), mercury (Hg), faecal coliform count (FCC), total coliform count (TCC) and escherichia coli count (ECC) were observed to be absent in the sachet water sample, which implies that the sachet water have been treated for these harmful heavy metals and biological parameters.

Table 3.4: Correlation Coefficients between parameters in Sachet water produced in Uli

	Correlation between Vectors of Values								
	pH	Temp.	Turb.	Cond.	Mg^{2+}	Na^{+}	K^{+}	SO_4^{2-}	Cl^{-}
pH	1.000								
Temp.	0.000	1.000							
Turb.	-0.690*	0.000	1.000						
Cond.	-0.303	0.000	0.434	1.000					
Mg^{2+}	-0.311	0.000	-0.108	0.341	1.000				
Na^{+}	0.000	0.000	0.000	0.000	0.000	1.000			
K^{+}	0.306	0.000	-0.135	0.404	-0.236	0.000	1.000		
SO_4^{2-}	0.208	0.000	-0.147	0.548*	0.277	0.000	0.285	1.000	
Cl^{-}	-0.229	0.000	0.341	0.868*	0.093	0.000	0.232	0.545*	1.000

* Significant correlation at 0.05 level of significance

The matrix of the correlation coefficients in Table 3.4 above shows that the positive correlation exists at a level of 0.05% value between conductivity and sulphate (SO_4^{2-}) in sachet water produced in the study area (r = 0.548), chlorine (Cl^{-}) and conductivity (r = 0.868) and between chlorine and sulphate (SO_4^{2-}) (r = 0.545), whereas a significant negative correlation appears to exist between turbidity and pH only (r = - 0.690). Temperature and non-content parameters were found to be unrelated to other parameters. As there was a significant correlation with the other parameters at the 0.05% value level. We therefore reject the null hypothesis (H_0) and accept alternative hypothesis (H_1) that there is an important correlation between certain selected physical, chemical and bacteriological parameters within the sachet water samples. This means that the bonding effect is significant and that the sachet water has good properties.

IV. Discussions And Integration With Past Studies

All samples were colourless, odourless and tasteless. The presence of colour, odour and taste in drinking water is not good for the consumer. Water samples were generally colourless, odourless and tasteless. Oyeku *et al* (2001) in their study of sachet water in Lagos in the metropolitan area reported that all the samples taken met the recommended standards. However, Edema *et al* (2001) in their study of the microbiological and physico-chemical properties of drinking water in Abeokuta, Nigeria, found that all samples had an unpleasant taste. The results obtained from the taste analysis indicate that the packaging materials used by these manufacturers were well received in the product. The median pH of the sachet water samples (6.688) decreased between range 6.5 - 8.5 specified by NAFDAC (2010) and WHO (2011). Therefore, water samples were unlikely to cause health problems such as acidosis (Okafor, 1999). Mean turbidity (0.85) of sachet water samples were below the maximum allowable limits of I0NTU and 5NTU respectively, set by NAFDAC (2010) and WHO (2011). At high levels, nitrate ion is known to lead to cyanosis in children (Pip, 2000). All sachet water samples usually have zero nitrate ion concentrations provided by NAFDAC and WHO at 10mg/l. The sulphate ion concentration (1.838) in water samples was significantly lower than NAFDAC (2010) and WHO (2011) recommended higher permissible limits of 100 mg/l and 400 mg/l, respectively. Chloride ions are non-toxic, an excessive amount that, if taken for a long time, can be harmful to health. NAFDAC (2010) and WHO (2011) recommended both 100mg/l and 250 mg/l as the maximum ion chloride levels allowed in drinking water. It is believed that high concentrations of chloride ions may cause taste problems. Water samples had low chloride ion levels (5.713 mg/l). No sodium evidence was found in water samples after laboratory analysis. There was zero values below the maximum limit of 200 mg/l recommended by both NAFDAC (2010) and WHO (2011). There is no evidence of adverse health effects directly caused by magnesium in established drinking water. Generally, all sachet water samples tested have positive bacteriological properties. Edema *et al* (2001) similarly noted that many types of water sold in Ibadan met WHO microbiological standards. This means that the analyzed water samples were produced under the best hygiene conditions or that the water was properly managed.

V. Conclusion

Access to safe drinking water is essential to health, a basic human right and part of an effective health protection policy. The importance of water, sanitation and hygiene in health and development is underscored by the results of a series of International Policy Forums especially the Millennium Development Goal Number 7 on the provision of safe drinking water to more than one billion slum dwellers. It was shown in the study that sachet water sold in Uli during the study met the recommended standards of good physical, chemical and microbiologically. Therefore, based on the results of the study, it is safe to conclude that the sachet water tested in the study area is suitable for drinking purposes.

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